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AERONAUTICAL ENGINEERING



A CONTINUING BIBLIOGRAPHY WITH INDEXES



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Introduction

This issue of *Aeronautical Engineering, A Continuing Bibliography with Indexes* (NASA SP-7037) lists 56 reports, articles, and other documents recently announced in the NASA STI Database.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.

Two indexes—subject and author are included.

The NASA CASI price code table, addresses of organizations, and document availability information are located at the back of this issue.

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Typical Report Citation and Abstract

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↓

ACCESSION NUMBER → **N96-10751#** Sandia National Labs., Albuquerque, NM. ← **CORPORATE SOURCE**

TITLE → **Minimizing phylogenetic number to find good evolutionary trees**

AUTHORS → Goldberg, Leslie Ann; Goldberg, Paul W.; Phillips, Cynthia A.; Sweedyk, Elizabeth (California Univ., Berkeley, CA.); and Warnow, Tandy (Pennsylvania Univ., Philadelphia, PA.) ← **AUTHORS' AFFILIATION**

PUBLICATION DATE → 1995 26 p Presented at the 1995 Symposium on Combinatorial Pattern Matching, Helsinki, Finland, 4-7 Jul. 1995 Sponsored by California Legislative Grant

CONTRACTS/GRANTS → Contract(s)/Grant(s): (DE-AC04-94AL-85000; NSF CCR-94-57800)

REPORT NO.(S) → Report No.(s): (DE95-011893; SAND-95-0831C; CONF-9507123-1) Avail: CASI HC A03/MF A01 ← **AVAILABILITY AND PRICE CODE**

ABSTRACT → Inferring phylogenetic trees is a fundamental problem in computational-biology. We present a new objective criterion, the phylogenetic number, for evaluating evolutionary trees for species defined by biomolecular sequences or other qualitative characters. The phylogenetic number of a tree T is the maximum number of times that any given character state arises in T. By contrast, the classical parsimony criterion measures the total number of times that different character states arise in T. We consider the following related problems: finding the tree with minimum phylogenetic number, and computing the phylogenetic number of a given topology in which only the leaves are labeled by species. When the number of states is bounded (as is the case for biomolecular sequence characters), we can solve the second problem in polynomial time. We can also compute a fixed-topology 2-phylogeny (when one exists) for an arbitrary number of states. This algorithm can be used to further distinguish trees that are equal under parsimony. We also consider a number of other related problems. DOE

SUBJECT TERMS → *Algorithms; Biological Evolution; Chemical Evolution; Genetics; Molecular Biology*

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 331)

JUNE 1996

01 AERONAUTICS (GENERAL)

No abstracts in this category.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

N96-21184* Boston Univ., Boston, MA.

Higher Order Boundary Element Methods for Subsonic and Supersonic Flows Ph.D. Thesis

Downey, Mark J.; et al 1 Jan. 1995 207 p

Report No.(s): (NIPS-96-34132) Avail: Univ. Microfilms Order No. DA9504108

This dissertation presents a higher-order formulation of the Boundary Element Method (BEM) applied to integral operators of interest in aerodynamics. The integral operators, in turn have been constructed using the Boundary Integral Equation Method (BIEM) from two basic linear differential operators; the Laplace equation, governing the field potential of an incompressible potential flow; and the linearized equation, governing the perturbation potential of a supersonic compressible potential flow-both constrained by appropriate boundary conditions. The resulting Boundary Integral Equation (BIE) related directly the unknown potential on the surface of the body to its normal derivative, which is known from the boundary conditions. Hence the methods discussed here are classified as direct; as opposed to indirect methods-wherein the potential is determined indirectly after solving for the unknown source density. The computation of higher-order coefficients involves the evaluation of source and doublet integrals with arbitrary intensity distributions over surface elements with arbitrarily smooth geometry.

Dissert. Abstr.

Boundary Element Method; Boundary Integral Method; Computational Fluid Dynamics; Incompressible Flow; Integrals; Linear Operators; Potential Flow; Subsonic Flow; Supersonic Flow;

N96-21187* Iowa State Univ. of Science and Technology, Ames, IA.

Design of Wing Section in Ground Effect: Application to High-Speed Ground Transportation Ph.D. Thesis

Hiemcke, Christoph; et al 1 Jan. 1994 364 p

Report No.(s): (NIPS-96-34098) Avail: Univ. Microfilms Order No. DA9503563

This dissertation attempts to fully explain the aerodynamic ground effect phenomenon, which occurs when a wing flies over a nearby plane. The long-term motivation is to determine the feasibility of a train that achieves aerodynamic levitation above a flat guideway. Such a train would rely exclusively on lifting surfaces, rather than on steel wheels, lifting fans or magnetic fields. As a first step in the study of an aerodynamically suspended train, a wing section must be designed. This dissertation focuses on the preliminary design and the experimental investigation of a two-dimensional airfoil in ground effect. For application to high-speed ground transportation, the airfoil is assumed to fly at approximately six degrees incidence and a ground distance 10 percent of its chordlength. Both the theoretical analysis and the wind tunnel experiment utilize two airfoils that are mirror images of one another. The symmetry plane between the two airfoils models the presence of the ground. The theoretical preliminary design makes use of inviscid panel methods. The work includes chapters on vehicles that use the aerodynamic ground effect, and on high-speed ground transportation systems. Possible directions for future research in the area of aerodynamically suspended trains are also suggested.

Dissert. Abstr.

Aerodynamics; Airfoils; Ground Effect (aerodynamics); Inviscid Flow; Surface Vehicles; Transportation; Wings;

N96-21253*# Analytical Services and Materials, Inc., Hampton, VA.

Implementation of algebraic stress models in a general 3-D Navier-Stokes method (PAB3D)

Abdol-Hamid, Khaled S.; et al 1 Dec. 1995 26 p

Contract(s)/Grant(s): (NAS1-19831; RTOP 505-59-30-24)

Report No.(s): (NASA-CR-4702; NAS 1.26:4702; NIPS-96-09040) Avail: CASI HC A03/MF A01

A three-dimensional multiblock Navier-Stokes code, PAB3D, which was developed for propulsion integration and general aerodynamic analysis, has been used extensively by NASA Langley and other organizations to perform both internal (exhaust) and external flow analysis of complex aircraft configurations. This code was designed to solve the simplified Reynolds Averaged Navier-Stokes equations. A two-equation k-epsilon turbulence model has been used with considerable success, especially for attached flows. Accurate predicting of transonic shock wave location and pressure recovery in separated flow regions has been more difficult. Two algebraic Reynolds stress models (ASM) have been recently implemented in the code that greatly improved the code's ability to predict these difficult flow conditions. Good agreement with Direct Numerical Simulation (DNS) for a subsonic flat plate was achieved with ASM's developed by Shih, Zhu, and Lumley and Gatski and Speziale. Good predictions were also achieved at subsonic and transonic Mach numbers for shock location and trailing edge boattail recovery on pressure a single-engine afterbody/nozzle model.

Author

Aerodynamic Configurations; Computational Fluid Dynamics; Flow Distribution; Navier-stokes Equation; Reynolds Stress; Separated Flow; Shock Wave Interaction; Shock Waves; Transonic Flow; Turbulence Models; Turbulent Flow;

N96-21259*# West Virginia Univ., Morgantown, VA. Dept. of Mechanical and Aerospace Engineering.

Estimation of the longitudinal and lateral-directional aerodynamic parameters from flight data for the NASA F/A-18 HARV Progress Report

Napolitano, Marcello R.; et al 1 Jan. 1996 51 p

Contract(s)/Grant(s): (NCC2-759)

Report No.(s): (NASA-CR-200251; NAS 1.26:200251; NIPS-96-08805) Avail: CASI HC A04/MF A01

This progress report presents the results of an investigation focused on parameter identification for the NASA F/A-18 HARV. This aircraft was used in the high alpha research program at the NASA Dryden Flight Research Center. In this study the longitudinal and lateral-directional stability derivatives are estimated from flight data using the Maximum Likelihood method coupled with a Newton-Raphson minimization technique. The objective is to estimate an aerodynamic model describing the aircraft dynamics over a range of angle of attack from 5 deg to 60 deg. The mathematical model is built using the traditional static and dynamic derivative buildup. Flight data used in this analysis were from a variety of maneuvers. The longitudinal maneuvers included large amplitude multiple doublets, optimal inputs, frequency sweeps, and pilot pitch stick inputs. The lateral-directional maneuvers consisted of large amplitude multiple doublets, optimal inputs and pilot stick and rudder inputs. The parameter estimation code pEst, developed at NASA

Dryden, was used in this investigation. Results of the estimation process from $\alpha = 5$ deg to $\alpha = 60$ deg are presented and discussed.

Author

Aircraft Models; Angle of Attack; Lateral Stability; Longitudinal Stability; Mathematical Models; Maximum Likelihood Estimates; Newton-raphson Method; Parameter Identification; Research Vehicles;

N96-21310* Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.

Residual Thermal Stresses around Bonded Fibre Metal Laminate Repair Patches on an Aircraft Fuselage

Vlot, A.; Soerjanto, T.; Yeri, I.; and Schelling, J. A.; et al 1 Nov. 1995 20 p

Report No.(s): (LR-799; ISBN-90-5623-028-X; NIPS- 96-34531) Copyright Avail: Issuing Activity (Delft Univ. of Technology, Faculty of Aerospace Engineering, PO Box 5058, 2600 GB Delft, The Netherlands)

The residual stresses present in an adhesively-bonded, S2-glass-fiber metal laminate (GLARE) patch used for structural repair of aircraft fatigue damage can degrade the effectiveness of the repair. Strain and temperature measurements were made on a repaired aircraft fuselage to determine the internal strains during and after curing. Thermal buckling of the skin was observed at a cure temperature of 105 C. At a lower cure temperature an outward bending was observed. The measured temperature field and the model of Rose were in agreement.

Derived from text

Adhesive Bonding; Aircraft Maintenance; Fiber Composites; Fuselages; Laminates; Metal Matrix Composites; Residual Stress; Skin (structural Member); Thermal Stresses;

N96-21321* Wichita State Univ., Wichita, KS.

A Multi-Point Model for the Analysis of Aircraft Motion in Complex Flow-Fields Ph.D. Thesis

Jaramillo, Paul Thomas; et al 1 Jan. 1994 180 p

Report No.(s): (NIPS-96-34099) Avail: Univ. Microfilms Order No. DA9505090

A new set of aerodynamic functions and accompanying variables have been developed to facilitate the modeling of the highly nonlinear aerodynamic processes which pervade during spinning and other complex motions of aircraft in low-speed regimes. The functions and variables have been deduced from established aerodynamic theory, and incorporate many of the lessons of a long line of spin research. The variables are related to the usual dynamic variables and some basic aircraft geometry, but remain smoother over the course of a spin than do, conventional variables. The aerodynamic model takes advantage of static wind tunnel data, however, parameter estimation techniques using actual flight test data, are required to complete the model. To illustrate the methodology, a full kinematic, dynamic and aerodynamic model of

a specific aircraft was developed. A full evaluation of the model requires special estimation techniques, however, preliminary results using actual spin data indicate that the model structure and variables provide a breakthrough in analyzing spin data. The equations are efficient enough for use in real-time simulators as well as many other applications. Therefore, this work provides not only a powerful technique for the analysis of complex aircraft motions, but also forms a strong foundation for further spin research and a basic model for robust spin simulation.

Dissert. Abstr.

Aerodynamic Characteristics; Dynamic Models; Flow Distribution; Nonlinearity; Real Time Operation; Wind Tunnel Tests;

N96-21335* Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

Flow Measurements for an Afterbody in a Vertical Wind Tunnel

Skare, P. E.; et al 1 Jun. 1995 94 p

Report No.(s): (LR-792; ISBN-90-5623-021-2; NIPS-96-34525) Copyright Avail: Issuing Activity (Delft Univ. of Technology, Faculty of Aerospace Engineering, PO Box 5058, 2600 GB Delft, The Netherlands)

This report gives an overview of the flow measurements performed in the vertical boundary layer tunnel at the Faculty of Aerospace Engineering at TU-Delft. Both the flow conditions in the wind tunnel and the flow induced by an afterbody with an ellipsoid shape have been investigated. The wind tunnel flow was found to have perfect uniformity in the free stream, while the boundary layer generated on the fore- and afterbody was found to be influenced by low-frequency fluctuations generated in the settling chamber. However, the two-dimensionality was found to be in order at the measuring stations. Hot-wire anemometry (single and X-wire probes) was used to unveil both the mean and fluctuating part of the turbulent flow. Both the boundary layer attached to the afterbody and the free shear layer from the outlet of the tunnel were investigated. The boundary layer started as a typical weak favorable boundary layer and turned into an adverse pressure gradient type boundary layer further downstream, due to the curvature of the ellipsoid. At the end of the afterbody, the attached layer and the free shear layer merged together.

Author

Afterbodies; Ellipsoids; Flow Measurement; Wind Tunnel Tests;

N96-21345* Polytechnic Univ., Brooklyn, NY.

A wind tunnel study of supersonic vortical wakes from tip vortex generators Ph.D. Thesis

Wang, Frank Young; et al 1 Jan. 1994 150 p

Report No.(s): (NIPS-96-08075) Avail: Univ. Microfilms

Order No. DA9431744

The results of the investigation on vortical wakes emanating from tip vortex generators in Mach 3 and Mach 2.5 streams are presented. Time-averaged vortex-wake trajectories and the properties of the supersonic tip vortices have been inferred from pitot pressure survey in conjunction with a shadowgraphy based flow visualization technique. In many respects, the observed supersonic tip vortex behaves much like its low speed free vortex counterpart, that is a two-dimensional vortex superimposed on a uniform freestream velocity but with a compressibility correction. An unexpected result was that the temperature profile across the vortex is found to be approximately constant. The downstream convection of the tip vortices appeared to proceed with negligible diffusion in the near-field studied, while viscous wake diffuses much more quickly within the same downstream distances. It was also found that the trailing supersonic tip vortices, although estimated to be weak in terms of swirl angles, appear to include a substantial stagnation pressure deficit. These large stagnation pressure deficits in the vortices could constitute a significant portion of the total drag for low aspect ratio planforms. Based on these findings, it is proposed that, as a first approximation, the vortex-wake hazard problem of the future HSCT fleet may be assessed using the existing low speed results.

Dissert. Abstr.

Flow Velocity; Free Flow; Low Speed; Mach Number; Supersonic Flow; Supersonic Speed; Supersonic Wakes; Trailing Edges; Trajectories; Viscous Flow; Vortex Generators; Vortices; Wind Tunnel Tests;

N96-21353* Stanford Univ., CA.

A wake integral method for experimental drag measurement and decomposition Ph.D. Thesis

Shoemaker, William Condon; et al 1 Jan. 1994 180 p

Report No.(s): (NIPS-96-08962) Avail: Univ. Microfilms Order No. DA9508451

This thesis presents a method for using experimental wake survey data to compute the drag force acting on a finite lifting wing. This method is particularly valuable because it can be used to separate the drag force into induced and profile components. Because the induced drag computation is based on the measured vorticity distribution rather than a specified wake shape, this method provides accurate results even for cases where conventional panel methods break down. The basis for this method is an expression for the total drag derived from simple momentum balance considerations. The framework for drag decomposition is developed by exploring the mechanisms responsible for drag in both inviscid and viscous flows. Experimental wake surveys are presented for two planar wings at both 4 deg and 9 deg angle of attack. Force balance data is used to evaluate the accuracy of the computed total drag. The induced drag is corrected for

wind tunnel wall effects, and span efficiency factors are computed for both wings.

Dissert. Abstr.

Computational Fluid Dynamics; Induced Drag; Integral Equations; Inviscid Flow; Lifting Bodies; Viscous Flow; Wakes; Wings;

N96-21354* Maryland Univ., College Park, MD.

A computational analysis of the unsteady phenomena associated with a hypersonic type 4 shock interaction Ph.D. Thesis

Lind, Charles Anthony; et al 1 Jan. 1994 211 p

Report No.(s): (NIPS-96-08957) Avail: Univ. Microfilms Order No. DA9508000

This dissertation describes the unsteady behavior of a Mach 8 type 4 shock interaction. The thin-layer approximation to the two dimensional Navier-Stokes equations, coupled with the total variation diminishing (TVD) scheme, is used to examine the shock interaction. Euler, laminar, and turbulent results are presented. Parametric studies indicate that the peak pressure and supersonic jet position are sensitive to the impinging shock location. Small changes in the impinging shock location or shock strength can result in large changes in the peak pressure and jet impingement location. The calculations also reveal that the unsteadiness associated with the type 4 interaction is a strong function of the impinging shock location. The oscillatory motion of the peak pressure is also dependent on the strength of the impinging shock. The unsteadiness associated with the interaction is a combination of a high frequency oscillation carried on a low frequency transient. One of two mechanisms were responsible for the unsteady behavior of the interaction. The first is associated with the transients and are related to the formation and shedding of shear layers within the shock layer and acoustical feedback between the distorted bow shock and the body. The second occurs when the impinging shock strikes the initial blunt body shock below the stagnation region, designated the type 4+ interaction, resulting in an unsteady separation region.

Dissert. Abstr.

Hypersonic Flow; Hypersonic Shock; Jet Impingement; Shock Wave Interaction; Shock Waves; Unsteady Flow;

N96-21398* Duke Univ., Durham, NC.

Nonlinear response of a fluttering plate subject to supersonic aerodynamic, thermal, and pressure loads Ph.D. Thesis

Hopkins, Mark Alan; et al 1 Jan. 1994 191 p

Report No.(s): (NIPS-96-34449) Avail: Univ. Microfilms Order No. DA9500519

Panel flutter is a self-excited aeroelastic phenomenon in which a panel's oscillations are derived from the energy absorbed from the supersonic flow over the panel. Linear and nonlinear structural responses of panels with supports on all

four sides have been studied for many years. Several aeroelastic issues were identified in recent years concerning the response of some aircraft external skins with three flexible boundaries. These concerns led to this investigation of the nonlinear responses of a thin, cantilevered panel subject to unsteady supersonic flow over the upper surface, a static temperature differential between the panel and its surroundings, and a static pressure differential between the upper and lower surfaces of the panel. Integral-differential equations describing the motion of the panel are derived using von Karman's large displacement theory and a Rayleigh-Ritz assumed mode approach. The solution to the governing equations is obtained through numerical integration in space and time. The transverse displacement of the panel is used to classify the panel response. There are six possible panel responses: the transverse displacement response may decay exponentially to $z = 0$, decay exponentially to a buckled state, oscillate harmonically about $z = 0$, oscillate harmonically about a buckled state, oscillate periodically, or oscillate nonperiodically. Examples of each panel response and the condition boundaries for which they occur are discussed. In-plane and transverse modal convergence analyses are conducted, and the panel length-to-width ratio and freestream Mach number dependence are determined. The steady state response of the panel is shown to be dependent upon the panel parameters, the external loading conditions and, in some instances, the initial conditions employed to start the temporal integrations.

Dissert. Abstr.

Aerodynamic Loads; Cantilever Plates; Dynamic Response; Dynamic Structural Analysis; Free Flow; Nonlinearity; Panel Flutter; Pressure Effects; Supersonic Flow; Temperature Effects; Unsteady Flow; Upper Surface Blowing;

N96-21415* Georgia Inst. of Tech., Atlanta, GA.

Airloads on Finite Wing in a Time-Dependent Incompressible Freestream Ph.D. Thesis

Gillam, David Allen; et al 1 Jan. 1994 189 p

Report No.(s): (NIPS-96-33385) Avail: Univ. Microfilms Order No. DA9511577

Special aerodynamic considerations must be made to accurately predict unsteady airloads on lifting surfaces which encounter time dependent freestreams. Examples such as a fighter during a catapult takeoff and an aircraft flying at low altitude through a downburst are discussed. A means of classifying the different types of time dependent freestreams is developed along with a summary of previous work accomplished for each type. This class of problems is unique because of the time dependency of the freestream. The following problems are addressed in both two and three dimensions: thin airfoil/wing in accelerated flight, fixed airfoil/wing in an oscillating freestream, and a pitching airfoil/wing in an oscillating freestream (Greenberg's airfoil problem). In the latter case, the time dependency of both

oscillations in pitch and in freestream speed (longitudinal direction only) is considered arbitrary and specified. A linear potential flow analysis is described with a mathematical model involving a velocity potential formulation which incorporates vorticity modeling of the lifting surface and wake. The thrust of the thesis is the development of a new approach called the modal method. With this method in 2-D, the bound vorticity is represented as a sum of chordwise vorticity modes, each with a unique coefficient which changes over time, all multiplied by a time dependent function. The modal method is later extended to 3-D with the addition of spanwise vorticity modes. For the three problems above (2-D and 3-D), the modal airloads are presented and compared to various other appropriate theories along with a discussion of the differences and similarities.

Dissert. Abstr.

Aerodynamic Loads; Free Flow; Incompressible Flow; Potential Flow; Unsteady Aerodynamics; Unsteady Flow; Wing Loading; Wing Oscillations; Wings;

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

N96-20503# Alliance Fire Systems, Inc., Hampton, VA.
Large Frame Aircraft (LFA) fire fighting validation. TCA/PCA methodology evaluation Final Report, 1 Dec. 1994 - 31 Jan. 1995

Hall, George F.; Partin, Benjamin R.; and Storm, John H.; Jan. 1995 59 p

Contract(s)/Grant(s): (F08635-93-C-0042)

Report No.(s): (AD-A300680; WL-TR-95-3071) Avail: CASI HC A04/MF A01

This technical effort examines the technical and analytical basis of the National Fire Protection Association's (NFPA) methodology for determining minimum fire fighting agent quantities and flow rates for airport fire departments. The objective is to establish the validity of this methodology as representative of actual crash site conditions, and as an accurate means of estimating required agent quantities to effectively control and extinguish large frame aircraft (LFA) exterior and interior fires. The research consists of an analysis of past experimental program data, LFA crash statistics, recent Air Force fire department LFA crash experience, and NFPA 403 explanatory documents to determine TCA/PCA methodology areas of technical and operational weakness.

DTIC

Aircraft Safety; Extinguishing; Fire Fighting; Fire Prevention; Flow Velocity;

N96-21104*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A Study of Large Droplet Ice Accretions in the NASA-Lewis IRT at Near-Freezing Conditions

Miller, Dean R.; National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH. Addy, Jr., Harold E.; American Inst. of Aeronautics and Astronautics, New York, NY. and Ide, Robert F.; Army Research Lab., Cleveland, OH. et al 1 Jan. 1996 32 p Presented at 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; Sponsored by American Inst. of Aeronautics and Astronautics, New York, NY.

Report No.(s): (NASA-TM-107142; E-10072; NAS 1.15: 107142; ARL-MR-294; AIAA PAPER 96-0934; NIPS-96-33182) Avail: CASI HC A03/MF A01

This report documents the results of an experimental study on large droplet ice accretions which was conducted in the NASA-Lewis Icing Research Tunnel (IRT) with a full-scale 77.25 inch chord Twin-Otter wing section. This study was intended to: (1) document the existing capability of the IRT to produce a large droplet icing cloud, and (2) study the effect of various parameters on large droplet ice accretions. Results are presented from a study of the IRT's capability to produce large droplets with MVD of 99 and 160 microns. The effect of the initial water droplet temperature on the resultant ice accretion was studied for different initial spray bar air and water temperatures. The initial spray bar water temperature was found to have no discernible effect upon the large droplet ice accretions. Also, analytical and experimental results suggest that the water droplet temperature is very nearly the same as the tunnel ambient temperature, thus providing a realistic simulation of the large droplet natural icing condition. The effect of temperature, droplet size, airspeed, angle-of attack, flap setting and de-icer boot cycling time on ice accretion was studied, and will be discussed in this report. It was found that, in almost all of the cases studied, an ice ridge formed immediately aft of the active portion of the de-icer boot. This ridge was irregular in shape, varied in location, and was in some cases discontinuous due to aerodynamic shedding.

Author

Aircraft Icing; Drop Size; Ice Formation; Wind Tunnel Tests;

N96-21251*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

Development of a real-time transport performance optimization methodology

Gilyard, Glenn; et al 1 Jan. 1996 18 p

Report No.(s): (NASA-TM-4730; H-2085; AIAA PAPER 96-0093; NAS 1.15:4730; NIPS-96-09032) Avail: CASI HC A03/MF A01

The practical application of real-time performance optimization is addressed (using a wide-body transport simulation) based on real-time measurements and calculation of in-

cremental drag from forced response maneuvers. Various controller combinations can be envisioned although this study used symmetric outboard aileron and stabilizer. The approach is based on navigation instrumentation and other measurements found on state-of-the-art transports. This information is used to calculate winds and angle of attack. Thrust is estimated from a representative engine model as a function of measured variables. The lift and drag equations are then used to calculate lift and drag coefficients. An expression for drag coefficient, which is a function of parasite drag, induced drag, and aileron drag, is solved from forced excitation response data. Estimates of the parasite drag, curvature of the aileron drag variation, and minimum drag aileron position are produced. Minimum drag is then obtained by repositioning the symmetric aileron. Simulation results are also presented which evaluate the affects of measurement bias and resolution.

Author

Aerodynamic Coefficients; Aerodynamic Drag; Aircraft Structures; Cambered Wings; Drag Reduction; F-111 Aircraft; Induced Drag; Lift; Optimal Control;

N96-21301*# Galaxy Scientific Corp., Atlanta, GA.
Results of a field study of the performance enhancement system: A support system for aviation safety inspectors Final Report

Layton, Charles F.; and Shepherd, William T.; et al 1 Dec. 1995 83 p

Contract(s)/Grant(s): (DTFA01-92-Y-01005)

Report No.(s): (DOT/FAA/AM-95/31; NIPS-96-06111)
 Avail: CASI HC A05/MF A01

The Performance Enhancement System (PENS) is a prototype electronic performance support system for Aviation Safety Inspectors (ASI's). PENS facilitates field data collection, information management, and on-line references, thus eliminating paperwork, redundant data-entry tasks, data errors, slow data-entry and turnaround times, and bulky paper references. PENS allows ASI's to collect field data in the format used by national FAA databases and it allows them to verify data at the time of inspection. A national field study of PENS was conducted. The study consisted of fielding four different computers to four ASI's in each of nine FAA Flight Standards District Offices across the country from November 1993 through March 1994. Study results indicate that the complex information management difficulties encountered by ASI's will not be solved by purchasing computer hardware alone. Rather, appropriate field software applications must be developed that will work in combination with field computer hardware to provide ASI's with a system of tools that supports their daily responsibilities. The ASI's must be closely involved in the continued development of these tools to ensure that they are designed to meet the inspectors' needs.

Author

Aircraft Safety; Computer Techniques; Data Acquisition; Data Systems; Ground Support Systems; Human-computer Interface; Inspection; Personal Computers; Portable Equipment;

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

N96-20262# Helsinki Univ. of Technology, Espoo (Finland).

Vehicle navigation systems as a means to reduce energy use in transportation: The selection of traffic assignment model and test vehicle equipment Annual Report

Karppinen, A.; 1995 33 p

Report No.(s): (PB95-265286) Copyright Avail: CASI HC A03/MF A01

The first section describes the selection of the traffic assignment model, and the characteristics of the chosen INTEGRATION model, its applications and development regarding the fuel consumption analysis. There are also some general remarks on the application of different fuel consumption models. The second part of the report describes the navigation and communication system of the test vehicle.
 NTIS

Electronic Equipment; Global Positioning System; Navigation Aids; Surface Navigation; Telecommunication; Test Vehicles; Traffic; Transportation;

N96-21147* Calgary Univ. (Alberta).

A robust quality control system for GPS navigation and kinematic positioning Ph.D. Thesis

Gao, Yang; et al 1 Jan. 1993 170 p

Report No.(s): (ISBN-0-315-83148-0; NIPS-96-06134)
 Avail: Univ. Microfilms Order No. DANN83148

The thesis describes the development and testing of a robust quality control system for GPS navigation and kinematic positioning. The system is built upon the successful combination of well-known classical statistics with modern robust statistics. Good performance in failure detection and identification, minimum implementation effort as well as automation are the main criteria employed in the development of the system. Theoretical and numerical aspects behind the system are presented along with the introduction of important concepts and the derivation of useful equations. The system was tested by applying it to integrity monitoring in GPS navigation and cycle slip detection and identification in GPS kinematic positioning and results show that significant improvements have been achieved as compared to the conventional approach.

Dissert. Abstr.

Failure Analysis; Global Positioning System; Positioning; Quality Control; Space Navigation;

N96-21461*# Oklahoma Univ., Norman, OK. Dept. of Psychology.

How Controllers Compensate for the Lack of Flight Progress Strips Final Report

Albright, Chris A.; Truitt, Todd R.; Barile, Ami B.; Vortac, O. U.; and Manning, Carol A.; et al 1 Feb. 1996 14 p
Contract(s)/Grant(s): (DTFA02-91-C-91089)
Report No.(s): (DOT/FAA/AM-96/5; NIPS-96-34679)
Avail: CASI HC A03/MF A01

The role of the Flight Progress Strip, currently used to display important flight data, has been debated because of long range plans to automate the air traffic control (ATC) human-computer interface. Currently, the Flight Progress Strip is viewed by many as an indispensable tool needed for the safe and expeditious separation of air traffic. Long term plans to automate the American system have initiated a debate on the impact of modifying, or even removing, the Flight Progress Strip. We looked at the viability of a stripless environment by using the Atlanta Center dynamic simulator to compare standard ATC operation with an experimental condition that removed the strips completely. Performance and perceived workload did not differ between conditions. Controllers compensated for the lack of strips by requesting more flight plan readouts. Without strips controllers took significantly longer to grant requests, and spent significantly more time looking at the plan view display.

Author

Air Traffic; Air Traffic Control; Air Traffic Controllers (personnel); Cognitive Psychology; Workloads (psychophysiology);

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

N96-21103*# Auburn Univ., AL. Dept. of Mechanical Engineering.

A New Treatment of Periodic Systems with Applications to Helicopter Rotor Blade Dynamics Final Report, 1 Sep. 1993 - 31 May 1995

Sinha, Subhash C.; et al 27 Jul. 1995 6 p
Contract(s)/Grant(s): (DAAH04-93-G-0452)
Report No.(s): (AD-A300866; ARO-32403.1-EG-DPS; NIPS-96-30941) Avail: CASI HC A02/MF A01

A computational facility, called the 'Nonlinear Systems Research Laboratory', totally dedicated to the dynamic analysis and control of linear/nonlinear mechanical systems with periodically varying parameters has been established. The main items include SUN desktop workstations, an IBM 486DX2/66 personal computer, a laser printer and some nec-

essary software. This research equipment is being used to develop new practical computational tools for bifurcation analysis and control of nonlinear dynamical systems which give rise to differential equations with periodic coefficients. These new strategies are applicable to general nonlinear time-periodic systems and can be applied to relatively large-scale problems. Unlike some of the existing techniques, such as perturbation and averaging, these methods would be free from small parameter limitations. The practical significance of this research is being demonstrated through applications of some typical engineering problems including the controller designs for a helicopter blade, a robot undergoing bifurcations and an asymmetric magnetic rotor-bearing system, among others. The SUN desktop workstations are used to perform the tremendous amount of numerical and symbolic computations required for this research work. The 486 PC and the laser printer are used to produce quality reports, graphs and research papers for proper dissemination of results on time.

DTIC

Computerized Simulation; Dynamical Systems; Nonlinear Systems; Rotor Dynamics;

N96-21296*# Georgia Inst. of Tech., Atlanta, GA. Aerospace Systems Design Lab.

Integrated design and manufacturing for the high speed civil transport (a combined aerodynamics/propulsion optimization study) Final Report

Baecher, Juergen; Bandte, Oliver; Delaurentis, Dan; Lewis, Kemper; Sicilia, Jose; and Soboleski, Craig; et al 16 Dec. 1995 21 p

Contract(s)/Grant(s): (NAGW-4337)
Report No.(s): (NASA-CR-200056; NAS 1.26:200056; NIPS-96-06120) Avail: CASI HC A03/MF A01

This report documents the efforts of a Georgia Tech High Speed Civil Transport (HSCT) aerospace student design team in completing a design methodology demonstration under NASA's Advanced Design Program (ADP). Aerodynamic and propulsion analyses are integrated into the synthesis code FLOPS in order to improve its prediction accuracy. Executing the integrated product and process development (IPPD) methodology proposed at the Aerospace Systems Design Laboratory (ASDL), an improved sizing process is described followed by a combined aero-propulsion optimization, where the objective function, average yield per revenue passenger mile (\$/RPM), is constrained by flight stability, noise, approach speed, and field length restrictions. Primary goals include successful demonstration of the application of the response surface methodology (RSM) to parameter design, introduction to higher fidelity disciplinary analysis than normally feasible at the conceptual and early preliminary level, and investigations of relationships between aerodynamic and propulsion design parameters and their effect on the objective function, \$/RPM. A unique ap-

proach to aircraft synthesis is developed in which statistical methods, specifically design of experiments and the RSM, are used to more efficiently search the design space for optimum configurations. In particular, two uses of these techniques are demonstrated. First, response model equations are formed which represent complex analysis in the form of a regression polynomial. Next, a second regression equation is constructed, not for modeling purposes, but instead for the purpose of optimization at the system level. Such an optimization problem with the given tools normally would be difficult due to the need for hard connections between the various complex codes involved. The statistical methodology presents an alternative and is demonstrated via an example of aerodynamic modeling and planform optimization for a HSCT.

Author

Aerodynamic Configurations; Aircraft Design; Aircraft Engines; Computer Aided Design; Experiment Design; Regression Analysis; Supersonic Transports;

N96-21360* California Univ., Los Angeles, CA.

Aeroelasticity and structural optimization of composite helicopter rotor blades with swept tips Ph.D. Thesis

Yuan, Kuo-An; et al 1 Jan. 1994 436 p

Report No.(s): (NIPS-96-33262) Avail: Univ. Microfilms Order No. DA9517734

This dissertation describes the development of an aeroelastic analysis capability for composite helicopter rotor blades with straight and swept tips, and its application to the simulation of helicopter vibration reduction through structural optimization. A new aeroelastic model is developed in this study which is suitable for composite rotor blades with swept tips in hover and in forward flight. The hingeless blade is modeled by beam-type finite elements. A single finite element is used to model the swept tip. Arbitrary cross-sectional shape, generally anisotropic material behavior, transverse shears, and out-of-plane warping are included in the blade model. The nonlinear equations of motion are derived using Hamilton's principle and based on a moderate deflection theory. Composite blade cross-sectional properties are calculated by a separate linear, two-dimensional cross section analysis. The aerodynamic loads are obtained using quasi-steady aerodynamics. This aerodynamic model is implemented in the computer code based on an implicit formulation. The trim and blade aeroelastic response is solved in a fully coupled manner. In forward flight, where the blade equations of motion are periodic, the coupled trim-aeroelastic response solution is obtained using the harmonic balance approach, and the stability of the periodic system, linearized about the time dependent equilibrium position, is determined from Floquet theory. Numerical results illustrating the influence of composite ply orientation, tip sweep, and anhedral on trim, vibratory hub loads, blade response, and stability are presented. It is found that composite ply orientation

has a significant influence on blade stability. The flap-torsion coupling associated with tip sweep can induce aeroelastic instability due to frequency coalescence. This instability can be removed by appropriate ply orientation in the composite construction. The structural optimization study is conducted by combining the aeroelastic analysis developed in this study with an optimization package to minimize the vibratory hub loads in forward flight subject to frequency and aeroelastic stability constraints, using composite ply orientations and tip sweep and anhedral as design variables. A parametric study showing the effects of tip sweep, anhedral, and composite ply orientation on blade aeroelastic behavior serves as a valuable precursor in selecting the initial design for the optimization studies. However the most appropriate combination of the design variables, for vibration reduction, can only be selected by the optimizer. Optimization results show that tip sweep has the most dominant influence on rotor vibration reduction.

Dissert. Abstr.

Aeroelasticity; Blade Tips; Dynamic Structural Analysis; Laminates; Rotary Wings; Rotor Dynamics; Structural Design; Structural Vibration; Vibratory Loads;

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

No abstracts in this category.

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

N96-20116*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

Analysis of fuel vaporization, fuel/air mixing, and combustion in lean premixed/prevaporized combustors

Deur, J. M.; (NYMA, Inc., Brook Park, OH.)Penko, P. F.; and Cline, Michael C.; (Los Alamos National Lab., NM.) 1995 20 p Presented at the AIAA/SAE/ASME Joint Propulsion Conference and Exhibit, San Diego, CA, 10-12 Jul. 1995

Contract(s)/Grant(s): (W-7405-ENG-36)

Report No.(s): (NASA-TM-111222; NAS 1.15:111222; DE95-015281; LA-UR-95-1971; CONF-950720-10) Avail: CASI HC A03/MF A01

Requirements to reduce pollutant emissions from gas turbines used in aircraft propulsion and ground-based power generation have led to consideration of lean premixed/prevaporized (LPP) combustion concepts. This paper describes a series of the LPP combustor analyses performed with

KIVA-2, a multidimensional CFD code for problems involving sprays, turbulence, and combustion. Modifications to KIVA-2's boundary condition and chemistry treatments have been made to meet the needs of the present study. The study examines the relationships between fuel vaporization, fuel/air mixing, and combustion in a generic LPP combustor. Parameters considered include mixer tube diameter, mixer tube length, mixer tube configuration (straight versus converging/diverging tubes), air inlet velocity, air inlet swirl angle, secondary air injection (dilution holes), fuel injection velocity, fuel injection angle, number of fuel injection ports, fuel spray cone angle, and fuel droplet size. Cases have been run with and without combustion to examine the variations in fuel/air mixing and potential for flashback due to the above parameters. The degree of fuel/air mixing is judged by comparing average, minimum, and maximum fuel/air ratios at the exit of the mixer tube, while flame stability is monitored by following the location of the flame front as the solution progresses from ignition to steady state.

DOE

Combustion Chambers; Exhaust Emission; Fuel Combustion; Fuel Injection; Fuel Sprays; Fuel-air Ratio; Gas Turbines; Turbulent Mixing; Vaporizing;

N96-20172# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).

Progress and new challenges in electronics and digital engine control

Collin, J. M.; Jun. 1994 13 p

Report No.(s): (PB96-101688) Copyright Avail: CASI HC A03/MF A01

Engine control systems, benefiting from continual progress in electronics, have become increasingly powerful and reliable while their cost and weight have decreased. Analog technology has gradually been replaced by digital technology, leading to gains in performance and reductions in cost while yielding implementations that are simpler and more uniform. Current massively redundant systems (FADEC) are evolving toward modular redundancy (multiprocessors implementing the parallelism of engine control functions), allowing previously hard-wired functions to be performed by software, thereby increasing flexibility for the designers. However, development difficulties have been compounded by the increasing number of functions performed, and this has not been entirely compensated for by Computer Aided Design and Computer Aided Software Engineering tools. The functional and operational complexity will continue to increase in the future, adding to design difficulties. A new approach appears necessary, whereby the functions are distributed among smart subsystems interconnected by fiber-optic links. This requires progress on standardization and high-temperature electronics.

NTIS

Aircraft Engines; Architecture (computers); Computer

Aided Design; Engine Control; Multiprocessing (computers); Numerical Analysis; Progress; Software Development Tools; Software Engineering;

N96-20201# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).

Modeling heat transfers in turbojet combustors

Schultz, J. L.; Mahias, O.; and Meunier, S.; Jun. 1994 10p
Report No.(s): (PB96-101712) Copyright Avail: CASI HC A02/MF A01

The analysis of heat transfers in the flame-holder system of a turbojet reheat is an essential part of the design process. This paper describes a computation methodology combining a 2D or 3D aerothermal code with a 3D thermal code. It describes the physical and numerical principles of the computation method used to determine the aerothermal fields. Then it rapidly reviews the thermal computation method and the methodology used to couple the results with those of the aerothermal code. Finally, the main steps in optimizing a reheat flame-holder are illustrated by an example that shows what numerical methods can contribute to development of turbojet combustors. The aerothermal code used, based on a finite element technique and a completely unstructured mesh, is described in detail.

NTIS

Combustion Chambers; Computerized Simulation; Finite Element Method; Supersonic Combustion; Turbojet Engines;

N96-20509 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).

Innovative methods for developing electronic control systems

Janvier, A.; Baufreton, P.; Gelineau, L.; and Olivier, C.; Jun. 1994 11 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
Report No.(s): (PB96-101696) Copyright Avail: CASI HC A03

This paper addresses the safety issues associated with the design and development of electronic control systems and software. First, the paper describes the model and simulation used in designing the electronic control systems. They define a software architecture for the adopted biprocessor hardware architecture with respect to the elementary control task computation times subjected to hard real-time constraints. Then, the optimization of the static task placement for the purpose of determining the best software architecture to minimize the computation times, is discussed. Finally, the paper describes a formal validation technique for the automatic system specifications.

NTIS

Aircraft Engines; Architecture (computers); Computer Aided Design; Control Systems Design; Digital Systems; Electronic Control; Real Time Operation; Safety Factors;

N96-21406* Purdue Univ., Elkhart, IN.

Multivariable gas turbine engine controller design using quantitative feedback theory Ph.D. Thesis

Nordgren, Richard E.; et al 1 Jan. 1994 196 p

Report No.(s): (NIPS-96-34494) Avail: Univ. Microfilms Order No. DA9513038

Complex thermo-fluid systems pose many difficult engineering problems in the area of automatic control system design. Typically, thermo-fluid systems exhibit nonlinear behavior, a high degree of process uncertainty, as well as transport lag and other time delay behaviors. The jet aircraft engine is a good example of one such system where the linearized dynamical behavior varies widely over the ranges of power code, altitude and flight Mach number. The customer demands high system performance levels, efficiencies, and safety margins with the aid of automatic control despite the high level of system complexity and uncertainty. The development of suitably powerful controller design techniques for this type of problem is therefore of considerable importance. There exist many distinct controller design techniques capable of producing control laws that are robust in the sense that they are immune to variations in the linearized models used to characterize non-linear system dynamical behavior. Quantitative Feedback Theory (QFT) is one such technique that seeks to break down multiple-input multiple-output system control problems into a series of single-input single-output (SISO) problems. QFT relies on a graphical synthesis approach to controller design, converting the performance and stability objectives into gain-phase bounds on the magnitudes of the individual SISO loop transmission functions. It is in this spirit that this work is undertaken, replacing much of this heuristic development in favor of a more thorough, mathematically rigorous approach, while retaining the powerful graphical design method. This thesis contains a motivation for the use of robust control within the framework of turbo-mechanical systems, a review of the historical development of multivariable aircraft engine control, a concise mathematical description of the control problem, and a mathematically rigorous mechanism for carrying out the design of robust control laws. An application of the theory is then brought to bear on a particular multivariable engine control problem; that of the General Electric GE16 afterburning, gas turbofan aircraft engine.

Dissert. Abstr.

Aircraft Engines; Complex Systems; Control Systems Design; Engine Control; Feedback Control; Gas Turbine Engines; Multivariable Control;

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N96-21205* Georgia Inst. of Tech., Atlanta, GA.

Nonlinear Flight Control Using Neural Networks Ph.D. Thesis

Kim, Byoung Soo; et al 1 Jan. 1994 197 p

Report No.(s): (NIPS-96-33389) Avail: Univ. Microfilms Order No. DA9511588

This thesis presents the theoretical development and numerical investigation of a direct adaptive tracking control architecture using neural networks. Emphasis is placed on utilization of neural networks in a flight control architecture based on feedback linearization of the aircraft dynamics. Neural networks are used to represent the nonlinear inverse transformation needed for feedback linearization. Neural networks may be first trained off-line using a nominal mathematical model, which provides an approximate inversion that can accommodate the total flight envelope. Neural networks capable of on-line learning are required to compensate for inversion error which may arise from imperfect modelling, approximate inversion or sudden changes in aircraft dynamics. A stable weights adjustment rule for the on-line neural network is derived. Under mild assumptions on the nonlinearities representing the inversion error, the adaptation algorithm assures that all the signals in the loop are uniformly bounded and that the weights of the on-line neural network tend to constant values. Simulation results for an F/A-18 aircraft and an AH-64 helicopter model are presented to illustrate the performance of the on-line neural network based adaption algorithm.

Dissert. Abstr.

Adaptive Control; Aerodynamic Characteristics; Algorithms; Feedback Control; Flight Characteristics; Flight Control; Neural Nets; Nonlinearity; On-line Systems;

N96-21266*# California Polytechnic State Univ., San Luis Obispo, CA. Dept. of Aeronautical Engineering.

Controls design with crossfeeds for hovering rotorcraft using quantitative feedback theory Final Report

Tischler, Mark B.; Army Aviation Systems Command, Moffett Fld. CA Biezad, Daniel J.; California Polytechnic State Univ., San Luis and Cheng, Rendy; California Polytechnic State Univ., San Luis et al 8 Jan. 1996 16 p

Contract(s)/Grant(s): (NCC2-833)

Report No.(s): (NASA-CR-200085; NAS 1.26:200085; NIPS-96-07768) Avail: CASI HC A03/MF A01

A multi-input, multi-output controls design with dynamic crossfeed pre-compensation is presented for rotorcraft in near-hovering flight using Quantitative Feedback Theory (QFT). The resulting closed-loop control system bandwidth allows the rotorcraft to be considered for use as an inflight simulator. The use of dynamic, robust crossfeeds

prior to the QFT design reduces the magnitude of required feedback gain and results in performance that meets most handling qualities specifications relative to the decoupling of off-axis responses. Handling qualities are Level 1 for both low-gain tasks and high-gain tasks in the roll, pitch, and yaw axes except for the 10 deg/sec moderate-amplitude yaw command where the rotorcraft exhibits Level 2 handling qualities in the yaw axis caused by phase lag. The combined effect of the QFT feedback design following the implementation of low-order, dynamic crossfeed compensators successfully decouples ten of twelve off-axis channels. For the other two channels it was not possible to find a single, low-order crossfeed that was effective. This is an area to be investigated in future research.

Author

Aircraft Models; Compensators; Control Systems Design; Cross Coupling; Decoupling; Feedback Control; Feedforward Control; Flight Simulators; Hovering; Quantitative Analysis; Rotary Wing Aircraft;

N96-21276*# California Polytechnic State Univ., San Luis Obispo, CA.

Rotorcraft flight control design using quantitative feedback theory and dynamic crossfeeds M.S. Thesis

Cheng, Rendy P.; et al 30 Jan. 1995 87 p

Contract(s)/Grant(s): (NCC2-833)

Report No.(s): (NASA-CR-200066; NAS 1.26:200066; NIPS-96-06201) Avail: CASI HC A05/MF A01

A multi-input, multi-output controls design with robust crossfeeds is presented for a rotorcraft in near-hovering flight using quantitative feedback theory (QFT). Decoupling criteria are developed for dynamic crossfeed design and implementation. Frequency dependent performance metrics focusing on piloted flight are developed and tested on 23 flight configurations. The metrics show that the resulting design is superior to alternative control system designs using conventional fixed-gain crossfeeds and to feedback-only designs which rely on high gains to suppress undesired off-axis responses. The use of dynamic, robust crossfeeds prior to the QFT design reduces the magnitude of required feedback gain and results in performance that meets current handling qualities specifications relative to the decoupling of off-axis responses. The combined effect of the QFT feedback design following the implementation of low-order, dynamic crossfeed compensator successfully decouples ten of twelve off-axis channels. For the other two channels it was not possible to find a single, low-order crossfeed that was effective.

Author

Control Systems Design; Cross Coupling; Feedback Control; Flight Control; Helicopter Control; Hovering; MIMO (control Systems); Rotary Wing Aircraft;

N96-21334* Texas Univ., Austin, TX.

A mixed nonlinear/linear control design for optimal de-

scent trajectories Ph.D. Thesis

Kim, Theodore John; et al 1 Jan. 1994 126 p

Report No.(s): (NIPS-96-08954) Avail: Univ. Microfilms Order No. DA9506024

The problem of maximizing the final velocity of a non-thrusting vehicle descending to a specified location at a lower altitude is solved. The equations of motion that describe the glider are simplified by defining the mismatch controls. These controls play against the aerodynamic controls and account for the errors that arise from the model reduction. The performance index for the resulting two-player game included tuning parameters that bound the sizes of the mismatch controls. The first variation conditions from optimal control theory are used to determine the controls for an unconstrained-range descent. The neighboring extremal controls are then derived and added to the unconstrained-range controls in order to reach a specified downrange and cross-range. The tuning parameters are chosen to increase the performance of the control law, which successfully guides the glider to various downranges and crossranges around the unconstrained-range final location. The derived control law can be calculated in real time and produces final velocities that compare well with numerically-determined results from parameter optimization codes.

Dissert. Abstr.

Control Surfaces; Control Theory; Descent Trajectories; Equations of Motion; Linear Systems; Mathematical Models; Nonlinear Systems; Optimal Control; Trajectory Control;

N96-21366* Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

A System Look at Electromechanical Actuation for Primary Flight Control

Lomonova, E. A.; et al 1 Oct. 1995 124 p

Report No.(s): (LR-793; ISBN-90-5623-026-3; NIPS-96-34528) Copyright Avail: Issuing Activity (Faculty of Aerospace Engineering, Technische Univ., Netherlands)

An overview is presented of the emergence of the all-electric flight control system (FCS) or power-by-wire (PBW) concept. The development of the primary flight control electromechanical actuators (EMA's) is one of the essential steps in the implementation of the all-electric aircraft. There is a great deal of interest in the application of brushless motors (BM) with rare-earth magnet rotors using external commutation as EMA's for flight control systems. The BM with its simple mechanical construction represents a very complex nonlinear multivariable control plant. In contrast to the DC motor which has a more complicated mechanical design but a simple control structure, the BM machine must be fed with alternating currents of variable amplitude, frequency, and phase. It is for these reasons that no standard solution for the control of brushless motors has emerged as in the case of the DC motor. The purpose of this paper is to present a

theoretical investigation of EMA's based on the BM description: electromechanical architecture, magnet materials, operating principles, and electromagnetic processes. In order to design current, position, torque, and speed controllers for BM, the general theory of electromechanical and electromagnetic processes in electrical machines and power converters is used. This report describes a basic approach to the creation of mathematical models for BM with rectangular and sinusoidal current waves. The hardware for position, torque, and current control systems for EMA's is presented. This work also treats the analysis and synthesis of different aircraft power systems with EMA's. Finally, the basic approach for the preliminary design of EMA's is presented.

Author

Actuators; Control Systems Design; Electric Motors; Electromechanical Devices; Fly By Wire Control; Power Supply Circuits;

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

No abstracts in this category.

10 ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

No abstracts in this category.

11 CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; non-metallic materials; and propellants and fuels.

N96-20154# NGB Technologies, Inc., Ann Arbor, MI.
Analyses of natural gas burner scaling data Annual Report, 1 Oct. 1993 - 30 Sep. 1994

Dahm, W. J. A.; and Driscoll, J. F.; 22 Jan. 1995 65 p
Prepared in cooperation with Gas Research Inst., Chicago, IL

Contract(s)/Grant(s): (GRI-5094-260-2712)

Report No.(s): (PB96-100623; NGB-5094-260-2712-1; GRI-95/0125) Avail: CASI HC A04/MF A01

This report describes progress in analyses of data from the SCALING 400 project into the scaling characteristics of aerodynamics and low NO(x) properties of industrial natural gas burners. Measurements are being conducted at five burner scales ranging from 30 kW to 12 MW at the International Flame Research Foundation (IFRF), The John Zink Co., and The University of Michigan. Analyses of data from the entire range of scales is being conducted to extract scaling information for improved burners designs. Work at NGB Technologies during the past year concentrated on validation of data from the 30 kW and 300 kW tests at Michigan, along the comparison of these data with the 4 MW and 12 MW test data as well as additional 300 kW test data from the BERL. Numerical modeling of these cases to assist in analyses of the burner scaling data has also begun.

NTIS

Aerodynamics; Flames; Natural Gas; Turbulent Combustion;

N96-20192# Oak Ridge National Lab., TN.

Reciprocating sliding wear of in-situ reinforced silicon nitride

Yust, C. S.; 1995 20 p

Contract(s)/Grant(s): (DE-AC05-84OR-21400)

Report No.(s): (DE96-000760; DOE/OR-21400/T481)

Avail: CASI HC A03/MF A01

The reciprocating sliding wear response of two in-situ reinforced-silicon nitride compositions provided by AlliedSignal have been evaluated. The materials were prepared by AlliedSignal-Ceramic Components Division and were tested at conditions of interest to the Bendix Engine Controls Division (South Bend, IN) and AlliedSignal Research and Technology (Des Plaines, IL). The materials are being considered for a variety of new applications, and the current tests provide critical friction and wear values under anticipated operating conditions. Both pin and disk specimens of GS-44 and GN-10 in-situ reinforced silicon nitride of specified dimensions for wear testing were provided by the AlliedSignal participants. An initial series of tests examined the unlubricated behavior of these materials at elevated temperature (up to 900 C) in an inert atmosphere. The results revealed excessive levels of both friction and wear in the unlubricated condition. The test conditions were modified to include the use of jet fuel as a lubricant because of an intended application in that medium. The introduction of the lubricant resulted in very limited wear of both the pin and disk specimens.

DOE

Lubrication; Silicon Nitrides; Sliding Friction; Wear; Wear Resistance;

N96-20510 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).

Probabilistic model for prediction of LCF surface crack initiation in powder metallurgy alloys

Debussac, A.; and Lautridou, J. C.; Jun. 1994 10 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
Report No.(s): (PB96-101738) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

The low-cycle fatigue (LCF) life of the powder metallurgy nickel-based superalloys is diminished by surface cracks that initiate defects in materials. A probabilistic model has been developed to predict the size of surface crack initiation sites on the basis of a known defect size distribution. This model was generated using two sets of materials: a standard (i.e., as-received) alloy, and a 'seeded' material of the same composition but carrying a known distribution of ceramic inclusions. The model predictions were found to be in an excellent agreement with the results obtained using the seeded materials, as the defect size distribution was better known for the seeded alloy compared to the standard one. The results were also satisfactory for the as-received material with its two types of surface crack initiation defects: pores and ceramic inclusions.

NTIS

Crack Initiation; Cracking (fracturing); Fracture Strength; Nickel Alloys; Particle Size Distribution; Powder Metallurgy; Surface Cracks; Surface Defects; Turbojet Engines;

N96-21393* Princeton Univ., NJ.

An additive approach to supersonic combustion: Use of silane in hydrogen-air systems and consideration of pyrophoric metals Ph.D. Thesis

Papas, Paul; et al 1 Jan. 1994 235 p

Report No.(s): (NIPS-96-34659) Avail: Univ. Microfilms Order No. DA9510032

To gain an understanding of processes important in the ignition and extinction phenomena of hydrogen-air and silane/hydrogen-air systems, experiments were performed on the ignition of the hydrogen-oxygen system in a flow reactor device and the extinction of the hydrogen-air and silane/hydrogen-air diffusion flames in an opposed jet burner. These experiments were modeled with numerical calculations using detailed chemical mechanisms. The flow reactor induction period results revealed that the overall activation energy of the hydrogen-oxygen system is quite large (approximately equal to 600 kJ/mol) at temperatures below 1000 K and at 1 atmosphere. The induction period data and post-induction reactant profiles were well correlated using a detailed kinetic model. Experiments measuring the extinction strain rates of counterflow hydrogen-air and silane/hydrogen-air diffusion flames were also performed. The velocity profiles across these flames (and strain rates) were measured using laser-Doppler velocimetry (LDV). The fuel streams of the hydrogen-air extinction experiments were comprised of 12.0 to 18.5 mol% hydrogen in nitrogen impinging an air stream at system pressures of 1.0 and 0.5 atms. Calculated extinction strain rates hydrogen-air diffusion flames using detailed

chemistry agree within 20% of experimental values. Numerical simulations of the hydrogen-air system were also used to elucidate important chemical processes near the extinction state. An important finding has been that the calculated extinction flame temperatures (and strain rates) for given hydrogen concentrations exhibit a non-monotonic pressure dependence, similar to hydrogen-oxygen explosion limits. Experiments on silane/hydrogen-air diffusion flames were performed where silane and hydrogen comprised between 0.34-3.00 and 10-17 mol% of the fuel stream, respectively. Direct measurements of the extinction strain rates of these flames were made for the first time using laser-Doppler velocimetry. For the conditions studied, the results indicate the effect of dilution is more important than the chemical (and transport) effect of silane on the extinction conditions of the hydrogen-air system. This research also considers the use of pyrophoric metal particles to reduce the ignition time of the hydrogen-air system. Appendix A describes the phenomenon of pyrophoricity, the rapid combustion of nascent metal particles under ambient conditions, and presents a calculation that estimates the critical particle size under which this phenomena will occur.

Dissert. Abstr.

Chemical Reactions; Combustion Physics; Diffusion Flames; Extinction; Hydrogen Oxygen Fuel Cells; Metal Combustion; Metal Particles; Pyrophoric Materials; Reaction Kinetics; Silanes; Supersonic Combustion;

12 ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

N96-20290# Helsinki Univ. of Technology, Espoo (Finland).

Introduction to gas-particle fluid dynamics

Jokilaakso, A.; Yang, Y.; and Ahokainen, T.; 1994 51 p

Report No.(s): (PB95-266748; TKK-V-B100) Copyright Avail: CASI HC A04/MF A01

The aim of this report is to give a short introduction to the fluid dynamics of the gas-particle system. The particles can be either rigid solids or deformable droplets. First, the basic governing equations for the carrier gas phase and for the particle phases are presented. For the particle phases, both Eulerian and Lagrangian approaches are introduced. The Eulerian approach treats the particle phase as a continuum like another fluid phase, whereas the Lagrangian approach regards the particles as dispersed phases. Some comparative studies between the two approaches are also reviewed. The interaction concerning the forces exerting on the particles are discussed, focusing on drag coefficient of a

rigid particle, a deformable particle, and a cloud of particles as well.

NTIS

Computational Fluid Dynamics; Drops (liquids); Fluid Flow; Gas-solid Interactions; Particles; Smelting; Solids; Tensile Deformation; Vapor Phases;

N96-21142* Alabama Univ., Huntsville, AL.

A Two-Equation Turbulence Model for a Parabolized Navier-Stokes Code Ph.D. Thesis

Nicholson, Lynn Alan; et al 1 Jan. 1994 203 p

Report No.(s): (NIPS-96-34101) Avail: Univ. Microfilms Order No. DA9504134

The low Reynolds number two-equation turbulence model of Chien has been implemented into the Air Force Wright Aeronautical Laboratories Parabolized Navier-Stokes (AFWAL PNS) code using an efficient, vectorized, non-iterative, implicit, approximate-factorization, finite-difference scheme. This model has been extended to compressible flows, has been modified to improve its prediction of hypersonic flows, and has been compared with an algebraic Baldwin-Lomax turbulence model and experimental data. Test cases were done for $Re = 3.7 \times 10^6$ and Mach No. = 8 air flow over a 10.5/7.0 deg biconic nose cone at angles of attack of 0 and 10 deg. With only a 10% increase in computational time over the algebraic turbulence model, the two-equation turbulence model closely matched the experimental pressure and heat transfer data for both cases and achieved a significant improvement over the algebraic turbulence model.

Dissert. Abstr.

Aeronautical Engineering; Air Flow; Angle of Attack; Finite Difference Theory; Hypersonic Flow; Low Reynolds Number; Navier-stokes Equation; Turbulence Models;

N96-21206* Catholic Univ. of America, Washington, DC.

Variable Structure Control of Vortex-Induced Vibration Ph.D. Thesis

Hussein, Nagy Mohamed; et al 1 Jan. 1994 114 p

Report No.(s): (NIPS-96-33388) Avail: Univ. Microfilms Order No. DA9511767

The fundamentals of actively controlling vortex-induced vibration of flexible cylinders using the theory of robust controls are presented. A variable structure robust controller is devised to reject the persistent disturbances produced by the periodic shedding of vortices. In addition, the controller is capable of accommodating changes in the structural parameters of the cylinders and the non-linearities resulting from fluid-structure interactions. Finite element-based model of the vortex-induced vibrations of flexible cylinders is presented using the wake oscillator approach. The model is coupled with the time dependent flow-induced forcing function and integrated with the variable structure-sliding mode control strategy. The mathematical model de-

veloped is validated experimentally by testing various prototypes of flexible cylinders in a low-speed wind tunnel under various flow conditions. The effect of varying the design parameters of the controller and the cylinders on the attenuation of the vortex-induced vibrations is monitored. Emphasis is placed in this research effort on demonstrating the effectiveness of the variable structure-sliding mode controller in suppressing vortex-induced vibration of flexible cylinders. Dissert. Abstr.

Controllers; Design Analysis; Finite Element Method; Structural Design; Vibration; Vortices;

N96-21217* Old Dominion Univ., Norfolk, VA.

Vibration control with piezoelectric actuation applied to nonlinear panel flutter suppression Ph.D. Thesis

Lai, Zhihong; et al 1 Jan. 1994 119 p

Report No.(s): (NIPS-96-33288) Avail: Univ. Microfilms Order No. DA9514740

Panel flutter is a large-deflection limit-cycle motion excited by the airflow, which is only on one side of a panel. The objective of this research is to analytically study the panel flutter limit-cycle suppression using nonlinear vibration control techniques with piezoelectric actuation. It is well known that piezoelectric materials are characterized by their ability to produce an electrical charge when subjected to a mechanical strain. The converse piezoelectric effect can be utilized to actuate a panel by applying an electrical field. Piezoelectric actuators are driven by feedback controllers, and control the panel dynamics. For a simply supported panel with piezoelectric layers, the nonlinear dynamic equations of motion are derived by applying Galerkin's method to von Karman's large deflection equation. The aerodynamic force is predicted by using the first-order piston theory or quasi-steady supersonic theory. For controller design, controllers are developed for the bending-moment actuation with given in-plane force. For linear feedback control, linear quadratic regulator (LQR), linear quadratic Gaussian (LQG) dynamic compensator, and proportional derivative (PD) controllers are used and compared. For nonlinear control, Lyapunov's direct method is applied to the nonlinear dynamic model. The controller consists of two parts. One is the linear part which is designed by solving a Riccati equation, and another is the nonlinear part which is obtained by making the time derivative of a Lyapunov function to be negative. Numerical simulations based on the nonlinear dynamic model are performed. The numerical study shows that the maximum suppressible dynamic pressure can be increased about five times of the critical dynamic pressure, and the bending moment is much more effective in flutter suppression than the piezoelectric inplane force. Within the maximum suppressible dynamic pressure, limit-cycle motion can be completely suppressed, which means that the flutter free region is enlarged. For the actuator design, three kinds of configurations are considered, two-set, one-patched, and shaped actuators,

which are implemented by changing the shapes of electrodes. Two-set actuators perform better than one-patched actuators, and one-patched actuators may have better performance than the completely covered actuator. For a shaped actuator, the methods to design the shape and location of the actuator are developed. The best location of an actuator is near the leading edge of the panel. Besides the design of shape and location of actuators, the method to design the optimal thickness of actuators is also presented. For a collocated actuator and sensor or a self-sensing actuator, the shape of actuator is very important when the PD controller is used. For the sensor design, the method to design the shape and location of the piezoelectric sensors is developed. The optimal control performance can be achieved by shaped sensors with a simple fixed-gain PD controller. Numerical results demonstrate that piezoelectric materials are effective in panel flutter limit-cycle suppression. The flutter free region can be further enlarged, if the actuator is activated before the critical dynamic pressure being reached.

Dissert. Abstr.

Actuators; Control Systems Design; Feedback Control; Panel Flutter; Piezoelectric Transducers; Vibration Damping;

N96-21323* Purdue Univ., West Lafayette, IN.

Inverse problems in structural dynamics Ph.D. Thesis

Martin, Michael Tavis; et al 1 Jan. 1994 141 p

Report No.(s): (NIPS-96-34658) Avail: Univ. Microfilms Order No. DA9513026

Inverse problems in structural dynamics-where information about the structure is inferred from experimentally measured responses-are quite common but usually very difficult to solve. The frequency domain spectral element method is applied to a number of inverse problems in frame structures. Taking a wave propagation approach, the complicated multi-dimensional wave behavior in such structures is modeled using a collection of connected waveguides; emphasis is placed on the need for proper higher order waveguides and appropriate joint modeling. This approach is used to construct a dynamic model of the structure, from which the transfer functions relating input force and system response are obtained. These frequency-dependent transfer functions are first used to obtain force reconstructions by deconvolving the propagation behavior from experimentally measured acceleration responses. Consideration is given to aspects such as the use of multiple sensors and their location. By combining this technique with a search routine based on a stochastic generic algorithm, an iterative method to determine the location of an unknown impacting force is also demonstrated. Finally, these techniques are used to identify the size and location of damage (due to a crack) in a frame structure. The essence of the approach is that force reconstructions obtained from the measured responses and various guessed structural models are used in an iterative search to determine the crack parameters which best represent the ac-

tual damage. In each of the crack problems considered, a number of practical issues associated with the modeling of cracks are also addressed.

Dissert. Abstr.

Aircraft Configurations; Airframes; Cracks; Damage; Dynamic Response; Dynamic Structural Analysis; Inversions; Problem Solving; Stress Waves;

N96-21330* Ohio State Univ., Columbus, OH.

An Experimental Study of Mixing Enhancement in Jets with Vortex Generating Tabs Ph.D. Thesis

Reeder, Mark Franklin; et al 1 Jan. 1994 338 p

Report No.(s): (NIPS-96-33354) Avail: Univ. Microfilms Order No. DA9517071

An experimental study was undertaken to elucidate the mixing enhancement and noise reduction in a jet caused by tabs, simple protrusions into the flow, placed at the nozzle exit. Far-field acoustic spectra of underexpanded jets showed the elimination of screech and a decrease in broadband shock noise when tabs were placed at the nozzle exit. Time-averaged flow visualizations and Schlieren photography, taken at the NASA Lewis jet facility, revealed the dramatic distortion of an underexpanded jet with tabs. Pressure contours, taken downstream of the shock train, showed that the tabs caused significantly more entrainment of ambient air. It was inferred that the jet distortion and increased entrainment were due primarily to the action of streamwise vortices emanating from the tabs. Two component hot-wire data taken for a Mach 0.3 jet and laser Doppler velocimetry (LDV) data taken in a water tunnel constructed at the Ohio State University, the presence of streamwise vortices has also been verified in pressure-matched Mach 1.5 and Mach 2.0 jets with tabs. The means by which streamwise vorticity is generated by the tabs has been described using pressure gradient arguments and by an analysis of the vorticity dynamics. In addition to the measurements of mean quantities, dual-view instantaneous visualizations of both low speed incompressible jets and supersonic jets with tabs yield considerable insight into the kinematics of the jet mixing.

Dissert. Abstr.

Aerodynamic Noise; Flow Visualization; Jet Mixing Flow; Mach Number; Shock Waves; Supersonic Jet Flow; Tabs (control Surfaces); Vorticity; Water Tunnel Tests;

N96-21355* Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

Investigation of Large-Amplitude 1-DOF Rotational Galloping

Vanoudheusden, B. W.; et al 1 Sep. 1995 104 p

Report No.(s): (LR-794; ISBN-90-5623-023-9; NIPS-96-34529) Copyright Avail: Issuing Activity (Faculty of Aerospace Engineering, Technische Univ., Delft, Netherlands)

The nonlinear galloping dynamics of an aeroelastic oscillator with one rotational degree of freedom are examined. The configuration of the oscillator is a rigid prismatic bar of rectangular cross-section exposed to a wind perpendicular to its axis. A quasi-steady approach is used to model the aerodynamic loads and the damping and stiffness effects. The stiffness effects can be neglected if the perturbation by the wind field remains small. For larger wind speeds, the system is again described as a weakly perturbed Hamiltonian system, which includes the leading-order aerodynamic terms. Wind tunnel tests were performed on an oscillator in which limit-cycle amplitudes were recorded and compared to model results. High forcing-level tests revealed the predicted behavior of increased limit-cycle amplitudes, amplitude-dependent oscillation frequency, and dynamic divergence above a critical wind speed.

CASI

Aerodynamic Loads; Aeroelasticity; Dynamic Stability; Oscillations; Wind Effects; Wind Tunnel Tests;

N96-21361* Washington Univ., Seattle, WA.

An Experimental and Numerical Investigation of the Three-Dimensional Flow Field About a Ram Accelerator Projectile Ph.D. Thesis

Hinkey, John Benjamin; et al 1 Jan. 1994 139 p
Report No.(s): (NIPS-96-34491) Avail: Univ. Microfilms Order No. DA9434314

An experimental and numerical investigation of the three dimensional flow field associated with the ram accelerator projectile is presented. Experiments are performed which measure, with high spatial and temporal resolution, the tube wall pressure induced by a sub-caliber projectile as it travels supersonically through a tube containing a methane-based, pre-mixed combustible gas mixture. These experiments were performed in the sub-, trans-, and superdetonative regimes of a single stage and reveal the three-dimensional nature of the projectile flow field as affected by the projectile fins, various combustion phenomena, and the phenomenon of projectile canting. Numerical simulations of the non-reacting three-dimensional flow field using a finite-volume based, inviscid, second-order accurate computational fluid dynamics code help to reveal the structure of the flow field between the projectile and the tube wall and are compared to the experimental results. It is found that the flow field is highly influenced by the projectile fins and that the non-reacting, inviscid simulations agree well with the experimental results. Canting of the projectile is experimentally and numerically verified and is found to have a significant link to the phenomenon of superdetonative projectile unstarts.

Dissert. Abstr.

Computational Fluid Dynamics; Flammable Gases; Flow Distribution; Inviscid Flow; Methane; Projectiles; Ram Accelerators; Reacting Flow; Supersonic Combustion; Three Dimensional Flow;

N96-21363* Rensselaer Polytechnic Inst., Troy, NY.

An experimental study of the effects of free-stream temperature fluctuations on boundary layer heat transfer Ph.D. Thesis

Abramson, Harris Daniel; et al 1 Jan. 1994 133 p
Report No.(s): (NIPS-96-34486) Avail: Univ. Microfilms Order No. DA9434551

For some time it has been understood that free-stream turbulence will enhance boundary layer heat transfer. The effects of free-stream temperature fluctuations have not been studied but there is every indication that these too will affect boundary layer heat transfer. A propane burning gas grid has been designed to produce temperature fluctuations in the free-stream flow on the order of 3 C. The present experimental investigation addresses the effects of free-stream temperature fluctuations on boundary layer heat transfer. The study is conducted on a cylindrical leading edge flat test body immersed in a two-dimensional subsonic flow which is supplied by an open circuit wind tunnel. The constant heat flux test body is instrumented with thermocouples and pressure taps so that heat transfer coefficients and velocity distributions can be obtained. Free-stream velocity and temperature are measured with a combination of hot-wire anemometry and a cold-wire used as a resistance thermometer. It is found that there is an effect of free-stream temperature fluctuations on heat transfer. If the temperature and velocity are correlated in the free-stream flow then one can expect that the effect of the temperature fluctuations will be proportional to the free-stream turbulent heat flux correlation coefficient. In the present investigation a 6 percent degradation of the heat transfer from the test body surface is reported although given a different set of parameters the augmentation heat transfer can be expected. An empirical correlation for this effect is provided as is a more general analytical formula that shows the observed effect is a function of the free-stream values of the turbulent heat flux, the turbulence intensity and the thermal turbulence. The latter is defined as the rms free-stream temperature fluctuation normalized by the local temperature difference across the boundary layer.

Dissert. Abstr.

Boundary Layers; Free Flow; Heat Transfer; Heat Transfer Coefficients; Subsonic Flow; Temperature Effects; Turbulent Heat Transfer; Two Dimensional Flow; Velocity Distribution;

13 GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

N96-19769# Oak Ridge National Lab., TN.

Environmental effects of the US Antarctic Program's use of balloons in Antarctica

McCold, Lance N.; Eddlemon, Gerald K.; and Blasing, Terrence J.; Jun. 1995 76 p

Contract(s)/Grant(s): (DE-AC05-84OR-21400)

Report No.(s): (DE96-000853; ORNL/TM-13032) Avail: CASI HC A05/MF A01

The USAP uses balloons in Antarctica to conduct scientific research, to facilitate safe air transport, and to provide data for global weather predictions. However, there is the possibility that balloons or their payloads may adversely affect Antarctic fauna or flora. The purpose of this study is to provide background information upon which the USAP may draw when complying with its responsibilities under the National Environmental Policy Act of 1969, the Antarctic Treaty, and the Madrid Protocol.

DOE

Antarctic Regions; Balloons; Environment Effects; Environment Management;

N96-20161# National Renewable Energy Lab., Golden, CO.

Analysis and test results for a two-bladed, passive cycle pitch, horizontal-axis wind turbine in free and controlled yaw

Holenemser, Kurt H.; Oct. 1995 90 p

Contract(s)/Grant(s): (DE-AC36-83CH-10093)

Report No.(s): (DE95-009291; NREL/TP-442-7391) Avail: CASI HC A05/MF A01

This report surveys the analysis and tests performed at Washington University in St. Louis, Missouri, on a horizontal-axis, two-bladed wind turbine with teeter hub. The introduction is a brief account of results obtained during the 5-year period ending Dec. 1985. The wind tunnel model and the test turbine (7.6 m (25 ft.)) in diameter) at Washington University's Tyson Research Center had a 67 degree delta-three angle of the teeter axis. The introduction explains why this configuration was selected and named the passive cycle pitch (PCP) wind turbine. Through the analysis was not limited to the PCP rotor, all tests, including those done from 1986 to 1994, were conducted with the same teetered wind rotor. The blades are rather stiff and have only a small elastic coning angle and no precone.

DOE

Aerodynamic Stability; Directional Stability; Turbine Blades; Wind Tunnel Tests; Wind Turbines; Yaw;

N96-20512# Technische Univ., Delft (Netherlands).

Contributions, Delft University of Technology to the European Wind Energy Association Conference and Exhibition

Dec. 1994 116 p Conference held in Thessaloniki, Greece, 1994

Report No.(s): (PB96-104047; IW-94080R) Copyright Avail: CASI HC A06/MF A02

The following papers are included: Transverse wind velocity fluctuations and their effects on a wind turbine rotor; The choice of atmospheric turbulence models for stochastic rotor load calculations; Effect of different parameters using an integrated design approach; FOCUS, a design tool for structural optimization of rotor blades; DUWECS: a wind turbine design tool; Automatic generation of the structural equations for motion; Simulation of offshore wind turbines under stochastic loading; Validation through system identification: a decisive way towards dynamically reliable models; Using a personal computer as a cheap tool for identification and control of wind turbines in the field; Control of wind turbine systems to reduce vibrations and fatigue loading; Induced velocity distributions and axial loads on yawed rotors; Wind tunnel experiments for 'dynamic flow'; Measurements on the properties of the tip vortex of a rotor model; The effect of stall strips, Gurney flaps, and vortex generators on the performance of a stall controlled wind turbine; Observations of unsteady aerodynamic effects from pressure distributions on a rotating wind turbine blades; Full scale fatigue testing of wind turbine rotor blades; Fatigue behavior of fiberglass wind turbine blade material at the very high cycle range; and Fatigue behavior of wood-epoxy laminates for wind turbine rotor blades.

NTIS

Aerodynamic Loads; Conferences; Fatigue (materials); Structural Design; Turbine Blades; Unsteady Aerodynamics; Wind Turbines; Windpower Utilization;

N96-21135* Royal Netherlands Meteorological Inst., De Bilt (Netherlands).

Changes in tropospheric NO(x) and O3 due to subsonic aircraft emissions

Wauben, W. M. F.; Vanvelthoven, P. F. J.; and Kelder, H.; et al 1 Feb. 1995 80 p Sponsored by Dutch Civil Aviation Board (ISSN 0169-1651)

Report No.(s): (KNMI-WR-95-04; ISBN-90-369-2074-4; NIPS-96-06106) Copyright Avail: Issuing Activity (Royal Netherlands Meteorological Inst., De Bilt, Netherlands)

A three-dimensional chemical transport code CTMK was used to study the environmental effects of exhaust emission from subsonic aircraft. Calculations show that 30% to 70% of the nitrogen oxides (NO(x)) in the northern, midlatitude atmosphere at cruise altitude is a result of aircraft emissions, as opposed to 2% to 4% of global tropospheric NO(x). Aircraft emissions contribute 1% to 2% to global ozone (O3)

and 3% to 6% of O₃ in the North Atlantic flight corridor. For the year 2015 scenario, the percent contribution of NO(x) and O₃ from aircraft increases relative to other sources, while the absolute contribution of both approximately doubles compared to 1990. At northern midlatitudes, the NO(x) contribution will be larger than the contribution from lightning, while the O₃ contributions will be on the same order of magnitude.

CASI

Atmospheric Effects; Environment Effects; Exhaust Emission; Global Air Pollution; Midlatitude Atmosphere; Nitrogen Oxides; Ozone; Transport Aircraft;

N96-21438*# Denver Univ., Denver, CO. Dept. of Engineering.

Detection and Analysis of Aircraft-Produced Particles in the Stratosphere During the Stratospheric, Photochemistry Aerosol and Dynamics Expedition Final Report, 1 Sep. 1992 - 31 Aug. 1992

Wilson, James Charles; et al 25 Jan. 1996 3 p

Contract(s)/Grant(s): (NCC2-776)

Report No.(s): (NASA-CR-200518; NAS 1.26:200518; NIPS-96-34384) Avail: CASI HC A01/MF A01

The objectives of the work funded by this cooperative agreement were to utilize three instruments to study particles in the stratosphere. The first instrument is a dual channel condensation nucleus counter (ER-2 CNC II). The ER-2 CNC II detects particles larger than 0.008 micrometers in diameter. One channel of the dual channel instrument operates normally, counting all particles which reach the instrument. The second channel provides for heating of the sample so that the number of particles which survive heating to various temperatures can be counted. The second instrument is an aerosol sampler capable of capturing small particles (MACS).

Derived from text

Particles; Stratosphere;

14 LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and planetary biology.

No abstracts in this category.

15 MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

N96-21261*# Institute for Computer Applications in Science and Engineering, Hampton, VA.

Analysis of the Hessian for aeroelastic optimization Final Report

Arian, Eyal; et al 1 Dec. 1995 23p Submitted for publication

Contract(s)/Grant(s): (NAS1-19480; RTOP 505-90-52-01)

Report No.(s): (NASA-CR-198245; ICASE-95-84; NAS 1.26:198245; NIPS-96-09033) Avail: CASI HC A03/MF A01

The symbol of the Hessian for an aeroelastic optimization model problem is analyzed. The flow is modeled by the small-disturbance full potential equation and the structure is modeled by an isotropic (von Karman) plate equation. The cost function consists of both aerodynamic and structural terms. In the new analysis the symbol of the cost function Hessian near the minimum is computed. The result indicates that under some conditions, which are likely fulfilled in most applications, the system is decoupled for the non-smooth components. The result also shows that the structure part in the Hessian is well-conditioned while the aerodynamic part is ill-conditioned. Applications of the result to optimization strategies are discussed.

Author

Aeroelasticity; Design Analysis; Models; Structural Analysis; Von Karman Equation;

N96-21370* Rice Univ., Houston, TX.

A Vision-Based Fuzzy Logic and Neural Network Approach to the Control of Hyper-Redundant Robot Manipulators Ph.D. Thesis

Magee, Kevin Nowell; et al 1 Jan. 1994 114 p

Report No.(s): (NIPS-96-34649) Avail: Univ. Microfilms Order No. DA9514205

Hyper-redundant robot manipulators possess a very large degree of kinematic redundancy and are capable of motion similar to that of snakes and elephant trunks. Because of the computational burden required to calculate the pseudo-inverse of the manipulator Jacobian matrix for high degree of freedom robots, hyper-redundant manipulators have proven challenging to control by traditional methods. Additionally, control can be further complicated because the large number of joints and links in a hyper-redundant arm can be a source of measurement error in real-world systems. A fuzzy logic and neural network based control system for hyper-redundant arms is presented which operates on data from real-time vision. The neural network maps goal position and ori-

entation to desired arm configuration. A modified region fill algorithm is used to provide an estimate of the current configuration as seen in two camera views. A fuzzy logic rule base constructed from human intuition specifies motor signals which servo the arm from the current position to the goal position according to velocity profiles modeled after human goal-directed movement strategies. As a test case, the control system is applied to a thirty-two degree of freedom robot arm designed and built at Rice University. The controller is demonstrated to provide accuracy similar to that of humans on certain tasks. Although application is made specifically to a hyper-redundant arm, the control system developed in this research also could be applied to many lower degree of freedom manipulators, provided that their motion is heuristically easy to describe.

Dissert. Abstr.

Fuzzy Systems; Logic Circuits; Neural Nets; Vision;

16 PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

N96-21271*# Virginia Polytechnic Inst. and State Univ., Blacksburg, VA. Dept. of Aerospace and Ocean Engineering.

Flow structure generated by perpendicular blade-vortex interaction and implications for helicopter noise prediction. Volume 1: Measurements period ending 18 Jan. 1996

Wittmer, Kenneth S.; and Devenport, William J.; et al 1 Jan. 1996 346 p Original contains 4 color illustrations

Contract(s)/Grant(s): (NAG1-1539)

Report No.(s): (NASA-CR-200159; NAS 1.26:200159; NIPS-96-08142) Avail: CASI HC A15/MF A03

The perpendicular interaction of a streamwise vortex with an infinite span helicopter blade was modeled experimentally in incompressible flow. Three-component velocity and turbulence measurements were made using a sub-miniature four sensor hot-wire probe. Vortex core parameters (radius, peak tangential velocity, circulation, and centerline axial velocity deficit) were determined as functions of blade-vortex separation, streamwise position, blade angle of attack, vortex strength, and vortex size. The downstream development of the flow shows that the interaction of the vortex with the blade wake is the primary cause of the changes in the core parameters. The blade sheds negative vorticity into its wake as a result of the induced angle of attack generated by the passing vortex. Instability in the vortex core due to its interaction with this negative vorticity region appears to be the catalyst for the magnification of the size and intensity of the turbulent flowfield downstream of the interaction.

In general, the core radius increases while peak tangential velocity decreases with the effect being greater for smaller separations. These effects are largely independent of blade angle of attack; and if these parameters are normalized on their undisturbed values, then the effects of the vortex strength appear much weaker. Two theoretical models were developed to aid in extending the results to other flow conditions. An empirical model was developed for core parameter prediction which has some rudimentary physical basis, implying usefulness beyond a simple curve fit. An inviscid flow model was also created to estimate the vorticity shed by the interaction blade, and to predict the early stages of its incorporation into the interacting vortex.

Author

Blade Slap Noise; Blade-vortex Interaction; Flow Distribution; Incompressible Flow; Mathematical Models; Noise Prediction; Turbulent Flow; Velocity Measurement; Vortices; Vorticity;

N96-21280*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

Aeroacoustics of Supersonic Elliptic Jets

Khavaran, Abbas; NYMA, Inc., Brook Park, OH. and Georgiadis, Nicholas J.; American Inst. of Aeronautics and Astronautics, New York, NY. et al 1 Jan. 1996 18 p Presented at 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; Sponsored by American Inst. of Aeronautics and Astronautics,

Contract(s)/Grant(s): (NAS3-27186; RTOP 538-03-11)

Report No.(s): (NASA-TM-107148; E-10081; NAS 1.15: 107148; AIAA PAPER 96-0641; NIPS-96-33184) Avail: CASI HC A03/MF A01

The sound field due to a supersonic elliptic jet is studied by direct integration of the propagation equations. Aerodynamic predictions are based on numerical solution to the compressible Navier-Stokes equations in conservative law form, with a k-epsilon turbulence model. In the high frequency limit, the sound field is described by eigenrays that link the source of noise to an observer in the far-field. We assume that noise is dominated by fine-scale turbulence. Using methods derived from acoustic analogy, source correlation terms are simplified and a model is derived that relates jet noise intensity to the $7/2$ power of turbulence kinetic energy. Local characteristics of the source such as its strength, time- or length-scale, and convection velocity are derived from mean flow predictions. Numerical results are compared with data for a Mach 1.5 elliptic jet as well as for a round jet. The study suggests that three-dimensional directivity of noise for jets of arbitrary geometry may be predicted with reasonable accuracy when refraction by mean flow gradients is properly accounted for.

Author

Acoustic Propagation; Aeroacoustics; Aerodynamic Noise;

Aircraft Noise; Noise Intensity; Noise Prediction (aircraft); Supersonic Jet Flow;

17 SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

N96-20207# Defence Science and Technology Organisation, Canberra (Australia).

UAV mission analysis and planning support system

Henderson, Derek E.; Mar. 1995 41 p

Report No.(s): (AD-A299183; DSTO-TR-0162; DODA-AR-009-241) Avail: CASI HC A03/MF A01

DSTO provided support to an Army trial aimed at evaluating the operational concepts involved in deploying Unmanned Aerial Vehicles (UAV's) and Unattended Ground Sensors (UGS's) in northern Australia. The work described in this report was a component of the overall DSTO trial support and the purpose was to demonstrate how Information Technology could be utilized to support the operation of UAV's. To this end, a prototype Mission Analysis and Planning Support System (MAPSS) has been developed. MAPSS is a computer-based information management system for storing, managing, processing and displaying information required in the operation of UAV's.

DTIC

Command and Control; Data Management; Information Management; Information Systems; Management Information Systems; Mission Planning; Pilotless Aircraft; Support Systems;

N96-21394* Illinois Univ., Urbana-Champaign, IL.

The effects of task and multifunction display characteristics on pilot viewport allocation strategy Ph.D. Thesis

Seidler, Karen S.; et al 1 Jan. 1994 119 p

Report No.(s): (NIPS-96-34655) Avail: Univ. Microfilms Order No. DA9512543

Multifunction displays (MFDs) and other electronic repositories of information are increasingly being deployed in the flightdeck environment. As is the case with the more traditional dedicated displays they are replacing, there is often a need to scan between information sources (i.e., screens) in order to monitor dynamic information sources or integrate information across different screens. Yet there exists little understanding of the relationships between screens which are important in influencing information accessibility and usability in MFDs. Even less understood is how the database organization and navigational tools used to traverse the MFD drive pilot strategy in managing different tasks competing for the use of the limited number of available display viewports which serve as 'windows' into the contents of the

database. A study was conducted in an effort to identify important task and display characteristics influencing pilot strategy in allocating display viewports to tasks which require information contained MFDs. With the identification of the factors underlying choice of strategy we can begin to understand the factors which should drive effective MFD interface design and which can facilitate MFD-based multitask performance in the cockpit.

Dissert. Abstr.

Aircraft Equipment; Decision Making; Display Devices; Information Systems; Multiprogramming; Pilot Performance;

18 SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.

No abstracts in this category.

19 GENERAL

No abstracts in this category.

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